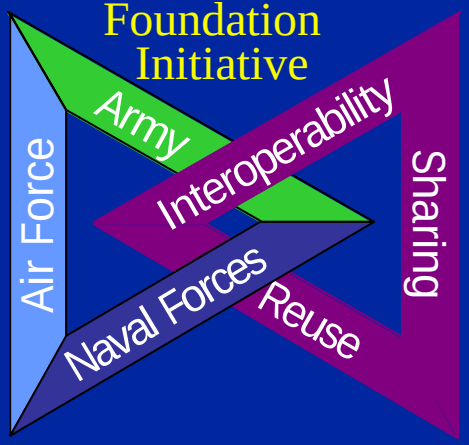
Technologies for Interoperability: Foundation Initiative 2010 and the Naval Collaborative Engineering Environment



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FI 2010 Cadre

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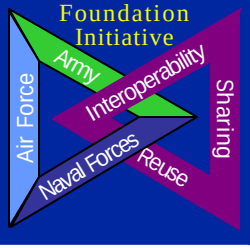
Foundation Initiative 2010 Mission Summary



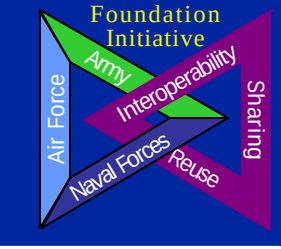
Provide the Core Products necessary to:

- Enable **Interoperability** among Ranges, Facilities, and Simulations in a quick, cost-efficient manner
- Foster **Reuse** for Range asset utilization and for future developments

- Supports the Warfighter (Joint Vision 2020)
- Enables SBA, STEP, CEE, JSB, and JDEP
- Fosters Test and Training Integration
- In the long term: SAVES MONEY!

Lay the Foundation for Future Range Instrumentation

Naval CEE Mission
"Engineer-In" Interoperability



T&E
- TEMP I&I Requirements
- DEP D-30/BGIT Process
- Analyze Test Trouble Reports
- Test Data Visualization & Analysis

Operational Support
- I&I Training Support
- Force Systems I&I Assessment
- Operational Support

Development
- Create and Maintain Force Systems I&I Database
- Acquisition Programs Tracking
- Create and Edit Status Reports
- Configuration Management

Naval CEE

CEE Tools

Design
- Force Systems Integration & Interoperability Architectures
- Interface Definition / Allocation
- Track System Design Issues to Requirements

- Requirements
- Distribution, Editing, Configuration Management of I&I Requirements Documents
- Force Systems I&I Requirements Traceability
- MOE's / MOP's

CEE Data / Document Repositories

*Adapted From the JDEP Report, 20 Oct 99

Supports Full System Acquisition Life-Cycle

Naval Collaborative Engineering Environment

Integrated Engineering Environment

OPNAV

ASN RDA CHENG

SYSCOMS

Joint Services

TAG

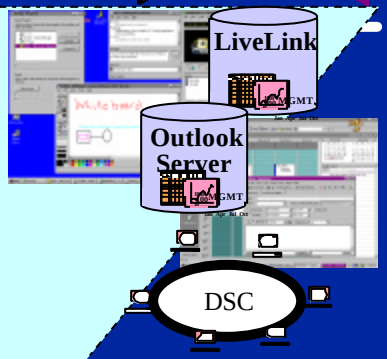
Fleet

NAVAL CEE

PEOs / PMs

Council of CHENGS

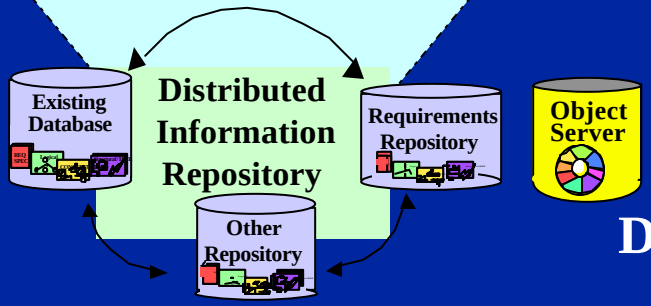
CINCS



Decision Support Environment

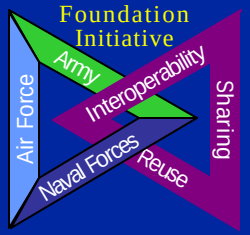
- Classified/Unclassified Connectivity
- Information Assurance

- Leverage Existing Infrastructure
- NMCI Reliance



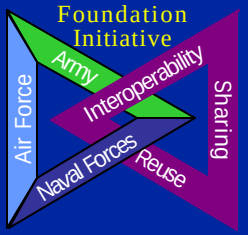
Interoperability
Data Mgt & Analysis

Means to Achieve the FI 2010 Mission



- **Common definition language – the TENA Object Model**
  - **Provides the community with a object/information definition mechanism tailored to the range users needs and requirements**
- **Common software infrastructure – the TENA Middleware**
  - **Encapsulates many common infrastructure needs and makes technological evolution of the middleware easier**
- **Common understanding of range processes – the Logical Range ConOps**
  - **Provides a common understanding to range users how logical ranges are created (from the integration of range resources), what their capabilities are, and how they are utilized, operated, and controlled**
  - **Common tools – the FI 2010 Tools**
  - **Provides reusable range software applications that perform ubiquitous functions such as resource management, logical range management, exercise visualization & monitoring, data collection, data analysis, etc.**

NCEE User Model



e-Systems Engineering Process

e-Business Process

Specialists
- Domain Experts
- System Developers
- Tool Developers
- DOORS
- CORE
- Rational Rose
- HCDE
- OPNET
- System Architect

Specialists Repository (Interchange, Oracle 8)

Execution Team
- CHENG Tech Team
- Contractors
- Labs
- Interchange
- DOORS
- CORE
- Rational Rose
- JMAAT
- M&S

Analysts Repository (Livelink, Public Folder)

Decision Makers
- CHENG staff
- Sponsors
- PEO's
- Fleet
- PM/contractors
- Web/Intranet access
- Livelink
- Netmeeting
- Groupsystems

EXTERNAL DATABASES

Program A | Program B | Program C

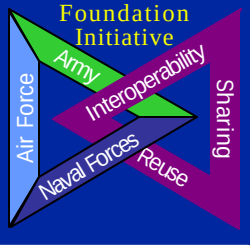
- Cost Data
- Requirement Data
- Function Data

Data Acquisition
IDMA

Data Analysis
IEE

Data Presentation
DSE

Foundation Initiative 2010 Product Overview



- Execution & Configuration Tools
- Instrumentation & Tactical Interfaces
- Range & Facility Standards
- DoD Standards
- Networks & Hardware

INTEROPERABILITY

FI 2010

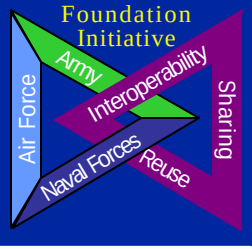
- **Selected T&E resource interfaces to TENA**
- **Performance reports of commercially available communication systems**
- **Procedures for executing synthetic, multi-range tests**

REUSE

Comply with the Joint Technical Architecture (JTA) & the High Level Architecture (HLA)

Leverage Existing DoD Networks & Commercially Available Hardware

Naval CEE Analysis Capabilities



Requirements Analysis (DOORS)
- Reqirements Aggregation
- Integration and Interoperability Reqts
- Interoperability MOE's/MOP's

Verified Mission Area Reqts
Functional Requirements

Force Architecture Definition
- JMAAT, DIAD, DMIR, JCAPS, MSTAR
  - AF Views
  - IER's
  - C4I SP's

- Physical Analysis (Interchange)
- Functional Allocation
- Assessments & Trades
- (HDWR/SFTWR/HUMAN)
- Product/Process/Program Mgt

Traceable Requirements
Verified Functional Arch
Human Organization

MCP
CED
SPP

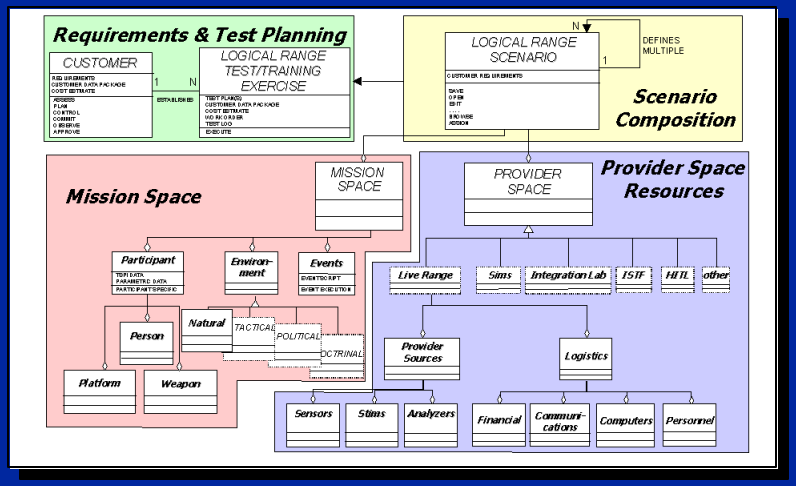
Functional Architecture
Logical Design

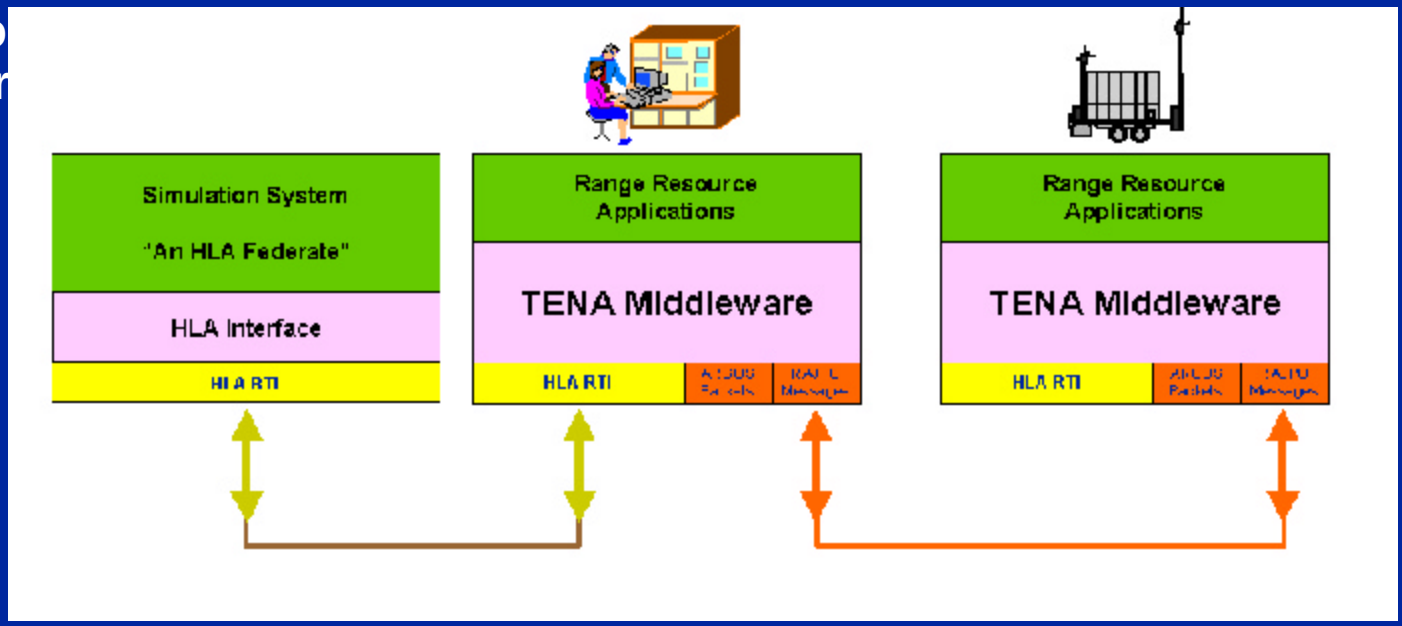
- Functional Analysis (CORE)
- Functional Decomposition
- Data Flow
- Control Flow
- Real Time Behavior

Large-Scale SE
Root Cause Analysis
Risk Assessment
HSI
AOA

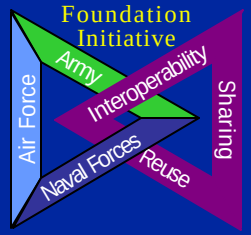
Test & Training Enabling Architecture (TENA)

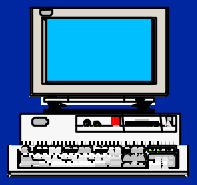
- **Object Model**
  - Data Elements of Test / Exercise
    - System-under-Test / Training Participant
    - Range and Facility Resources
  - Includes Resource Functionality
- **Services**
  - Specification fo
    Resources inter
- **Rules**
  - Requirements to be compliant
  - Standards & Protocols

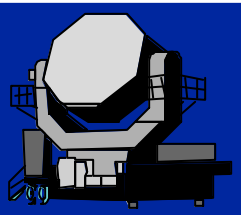


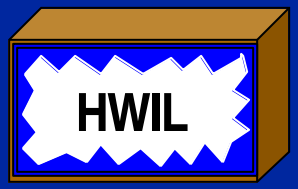


TENA Architectural Construct with FI 2010 Tools









Non-TENA System

Non-TENA System

Non-TENA Communications

Range Resource

Range Resource

Range Resource

TENA Gateway

TENA Interface Repository

TENA Middleware

Test / Exercise Data Archive

Test / Exercise Planner

Test / Exercise Manager

Data Collector

Resource Manager

Test / Exercise Analyzer

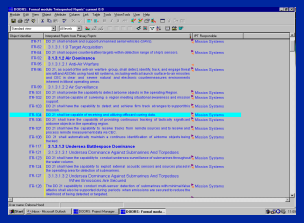
FI 2010 Tools

Repository Data View

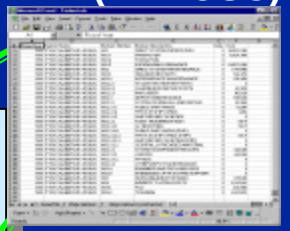
Foundation Initiative
Army
Air Force
Naval Forces
Interoperability
Sharing
Reuse

Data Repository (Interchange)

Requirement Analysis (DOORS)



System Cost (VAMOSC)



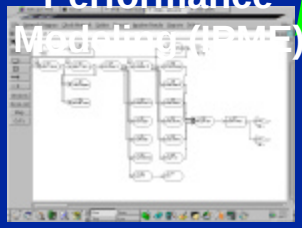
Reqs
Is Satisfied By
Cost
Funct
Implements
Has
Physical Dev
Implements
Has
Tasks
Used By
Human
Performs

Function Analysis (CORE)

Manning Cost (COMET)

Automation Guidance (IMAGE)

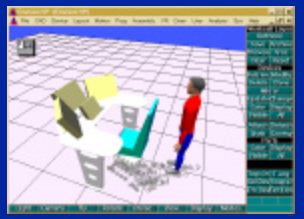
Human Performance Modeling (IPME)



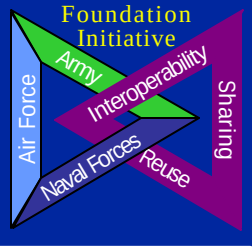
	DEV 1	DEV 2	OP A	OP B
X location	3	5	1	7
Y location	6	2	5	2
Orinetation	30	45	90	25
Score	2	3	1	4

Link Analysis (Prolink/Locate)

Human/Environment 3D Modeling (ENVISION/ERGO)



TENA Development Schedule



Foundation Initiative 2010

CTTRAs (1 thru 6)

OM Structure

Object Definitions

Standardization

TENA Project

TENA Baseline Report Oct 97

Domain Analysis

IKE

IKE 2

IKE 3

IOC

FOC

RCC Maintains Standards

Joint & Other CTEIP efforts

Service I&M projects

Development Test Cells

JADS SIT II

SETI

SimHARM

JTCTS

LOCAAS/JSF

JSF

Patriot

MC-02

Range systems interfaces

Comanche

HLA Experiments

Support Weapon Systems Tests

Phase 0 Initial Definition

Phase 1 Risk Mitigation

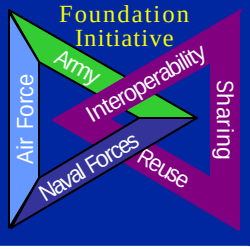
Phase 2 Technical Development

Phase 3 Implementation

Phase 4 Propagation & Maintenance

1998 2000 2002 2004

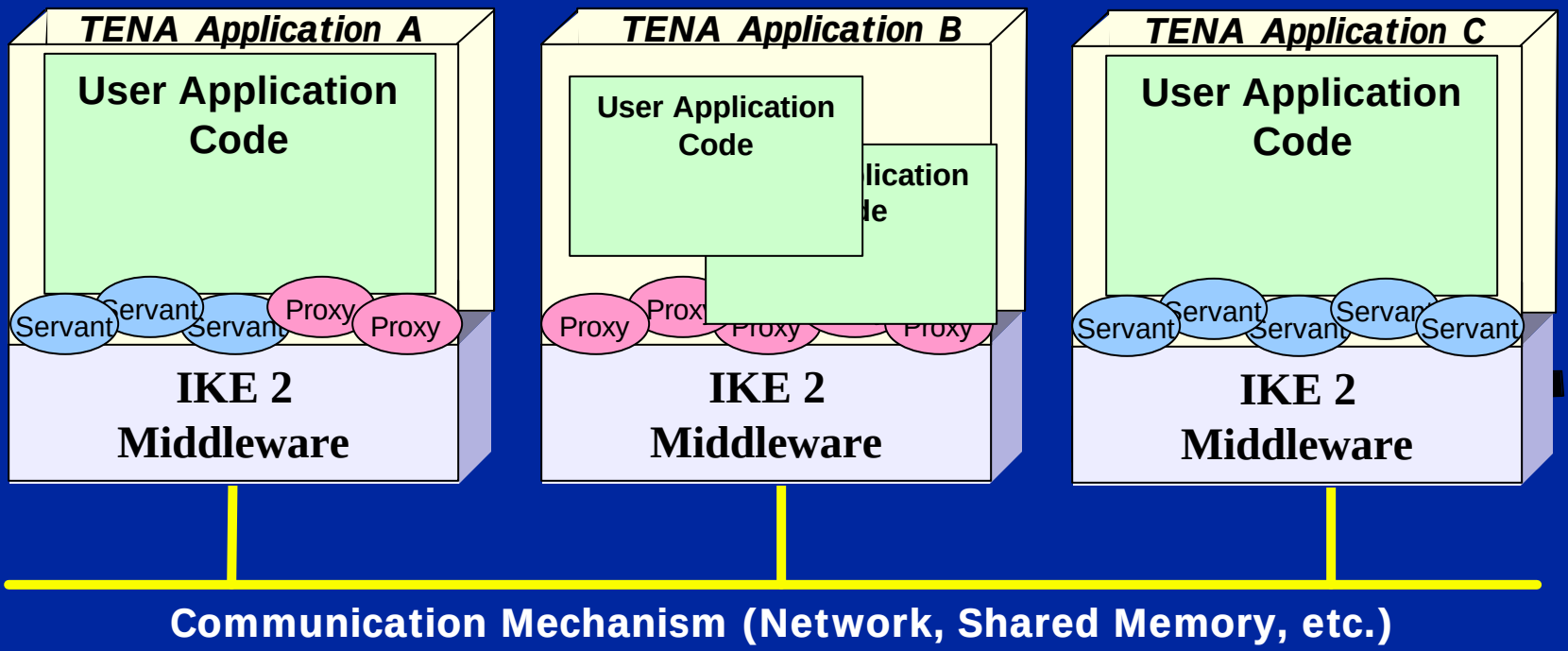
Naval CEE Components



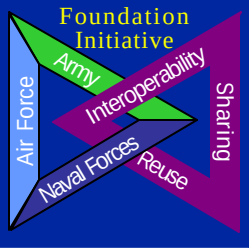
	Current	Planned
Decision Support Environment	Livelink VTC Netmeeting Secure Access Website Interim DSC	Livelink VTC Netmeeting MS Exchange 2000 Windows 2000 Web Enabled DSC SIPRNET
Integrated Engineering Environment	DOORS/CORE/ Interchange JMAAT HCDE	DOORS/CORE/ Interchange DIAD/DMIR, JMAAT Rational Rose HCDE M&S
Interoperability Data Management and Analysis	Portal (CEDAR) Interoperability Data Repository	CEDAR TCS Database Interoperability Data Repository Interoperability Knowledge Center

2nd TENA Middleware Prototype
Architectural Construct

TENA specifies an architecture for range resources participating in logical range executions



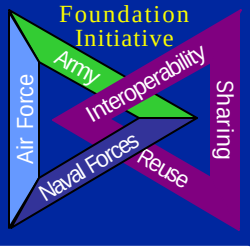
2nd TENA Middleware Prototype
Requirements

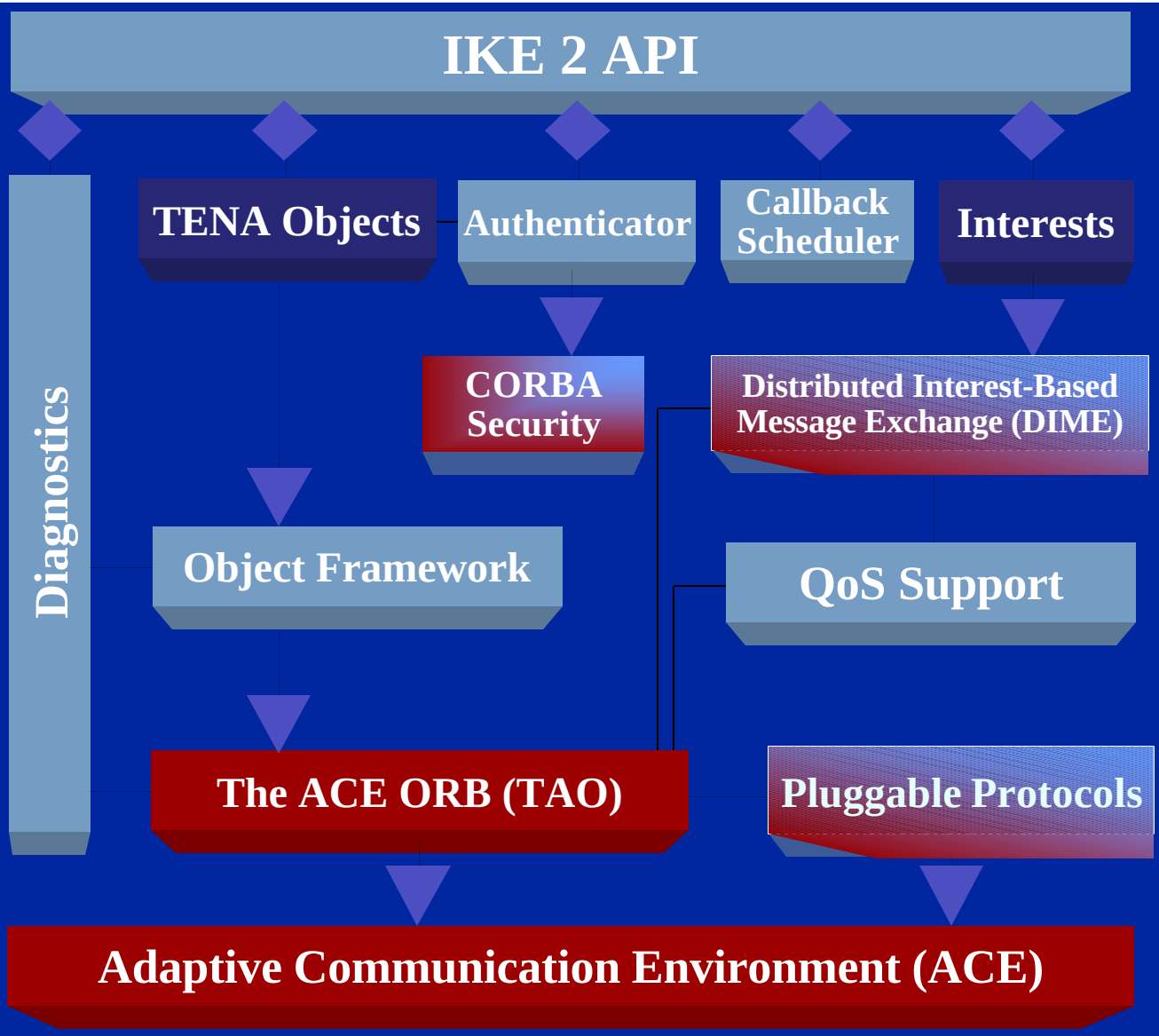


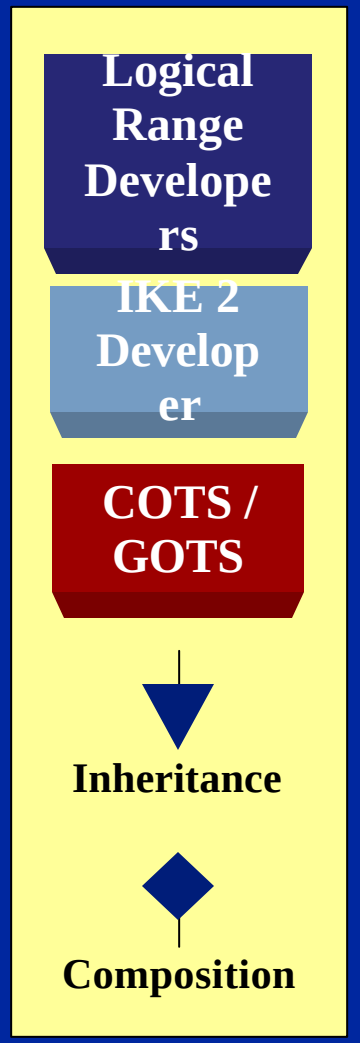
- **Defining the TENA Object Model**
  - Defining the TENA Classes
  - Object Relationships
  - The TENA Interface Repository
  - Instantiating Objects
  - Atomic State Updates
  - Object Security
- **TENA-to-TENA Communications**
  - Mechanisms
    - Publication State Updates
    - Remote Method Invocation
    - Messages
    - Data Streams (audio, video, telemetry)
    - Object Migration
  - Quality-of-Service
  - Subscription Services
  - Application Gateway (to legacy protocols)
- **TENA Exercise Management**
  - Barrier Synchronization
- **Support for:**
  - Multiple Threading Strategies
  - Multiple Processes
  - Internal Diagnostics
- **Non-Functional Requirements**
  - Security
  - Performance
  - Usability
  - Support multiple languages and platforms
- **Implementation**
  - Documentation/Help
  - Training
  - Testing

Reviewed at CTTRA XI

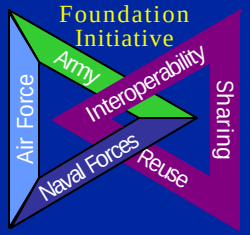
2nd TENA Middleware Prototype
Design







IKE 2 Release Schedule



Release 1 (Sep 2001)

- TENA Object Services
  - Object Instantiation
  - Object Composition & Relationships
  - Publication State Distribution
  - Data Integrity
  - Change Notification
  - Method Operations
- Interface Repository
- Multiple Platforms (Linux, Windows)

Release 2 (Dec 2001)

- TENA Object Services
  - Code generation support
- Built-In Diagnostics
  - Performance Metrics
- Gateway Support
  - Basic HLA gateway
- Multiple Languages
  - Java (currently evaluating need for r2)

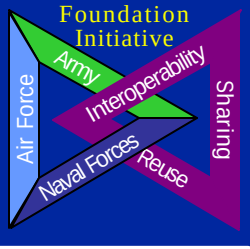
Release 3 (May 2002)

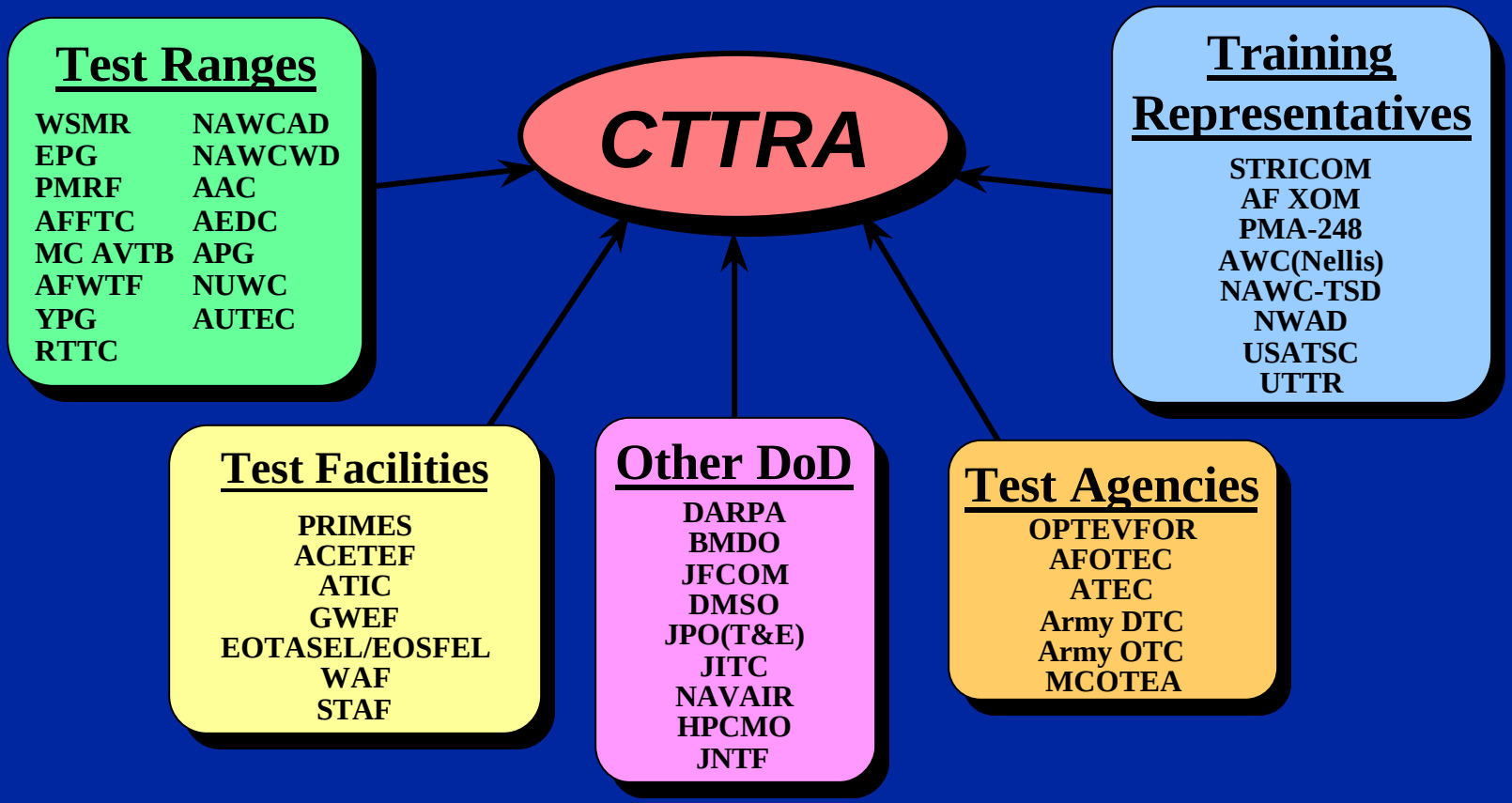
- TENA Object Services
  - Introspection
  - Ownership Management
- Messages and Data Streams
- Gateway Support
- Data Logging Support

Release 4 (Nov 2002)

- Access Control
- Security
- Additional Platforms (e.g., VxWorks)

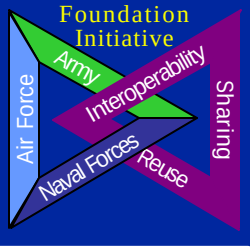
Common Test & Training Range Architecture (CTTRA)





- Systems engineers & software developers in the DoD Range and Facility community (both T&E and Training)
- 12 three-day workshops held (usually every 6-9 months)
- Last workshop was July 31- August 2 2001 (Colorado Springs, CO)

Architecture Management Team (TENA AMT)

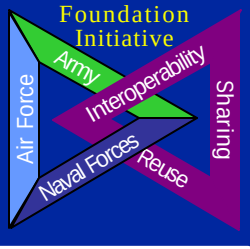


- **System Engineers & Technical Leads for the current major stakeholders of TENA**
  - AAC, Eglin AFB FL
  - NUWC, Newport RI
  - NAWC-AD, Pax River MD
  - WSMR, White Sands NM
  - RTTC, Huntsville AL
  - EPG, Fort Huachuca AZ
  - NAWC-WD, China Lake & Point Mugu CA
  - Virtual Proving Ground (VPG)
  - Common Training Instrumentation Architecture (CTIA)
  - PMRF Synthetic Range

Meetings every 4-6 weeks

- **Design Decisions / Trade-offs / Status**
- **TENA Use Cases / Prototype Test Strategies**
- **Technical Exchanges of Lessons Learned**
- **Issues & Concerns Identification, Investigation, & Resolution**

Range Modernization Towards TENA



Near Future

Existing Range Application
Existing Range Application
Existing Range Application
Existing Range Application
Existing Range Application
Existing Range Application
Range
TENA / Range Gateway
New TENA Application
Firewall to other sites

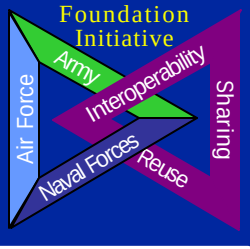
A Few Years

Existing Range Application
Existing Range Application
Existing Range Application
Existing Range Application
Range
TENA / Range Gateway
Re-architected TENA-compliant Application
Re-architected TENA-compliant Application
New TENA Application
New TENA Application
Firewall to other sites

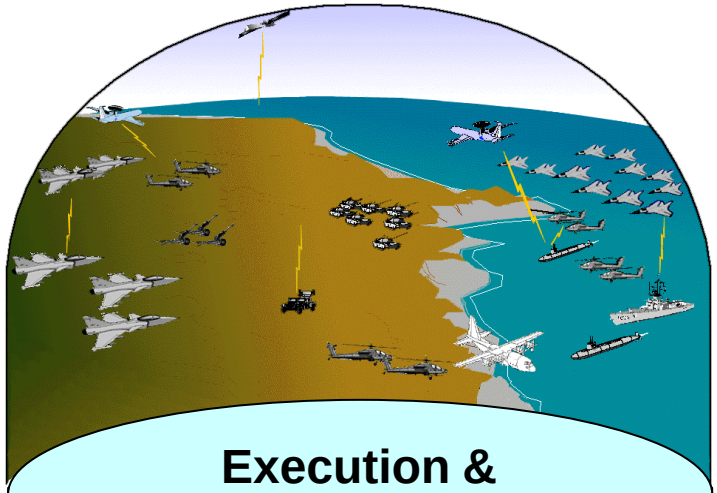
Event-ually

Existing Range Application
Range
TENA / Range Gateway
Re-architected TENA-compliant Application
New TENA Application
Re-architected TENA-compliant Application
Re-architected TENA-compliant Application
New TENA Application
New TENA Application
Firewall to other sites

Summary



- Foundation Initiative 2010 serves to acquire the necessary products for interoperability and reusability among ranges, facilities, and simulations
- The common architecture is called "TENA"
  - TENA being developed with "rapid prototyping" strategy (with the current prototype codenamed "IKE 2")
  - First release is next week (Sep 2001), with subsequent releases in Dec 2001, May 2002, and Nov 2002
  - TENA is slated to be the core architecture for VPG, JDEP, JSB, CEE, the range integration effort of MC-02, and the BMDO Data Fusion effort
  - TENA is supporting numerous weapon system programs and major commands, including JSF, Patriot, Comanche, J-7, and J-9
  - IKE 2 is already planned to be tested at 10 ranges
- Next AMT Meeting (AMT-08) is 10 – 11 Oct 2001



Lower Costs

Enhanced Testing

Improved Training

Execution & Configuration Tools

Instrumentation & Tactical Interfaces

Range & Facility Standards

DoD Standards

Networks & Hardware

INTEROPERABILITY

FT 2010

- resources to a Common Architecture
- Enables T&E resources to be easily reconfigured to support specific test missions
- Provides recommended practices and lessons learned for executing synthetic, multi-range test events

REUSE

Complies with the Joint Technical Architecture (JTA) & the High Level Architecture (HLA)

Leverages Existing DoD Networks & Commercially Available Hardware